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Guidelines for Evaluating Regeneration Before and After Clearcutting Allegheny Hardwoods

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Abstract

Use of the guides presented here will enable selection of Allegheny hardwood stands most likely to regenerate successfully after clearcutting. The guides are based on how well before-logging criteria predicted success in a number of stands 5 years after cutting. In comparison to earlier information, these guidelines recommend more small reproduction and higher quality, though fewer, stems of large reproduction. Guides to evaluate regeneration after cutting, based on both number and height of stems, are included also.

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Introduction

Regeneration requirements before clearcutting Allegheny hardwood stands were quantified first by Grisez and Peace (1973). These requirements were based on observations of regeneration in 65 stands scheduled for clearcutting and on the reexamination of those stands 2 years after cutting. They recommended that regeneration on a minimum of 10 randomly located plots be examined and each plot classed as stocked or not stocked. They defined a stocked plot as one having at least 15 black cherry stems or at least 80 stems of all desirable species[1] per 6-foot-radius plot. The stem counts included both seedlings and sprouts. If 70 percent or more of the plots were stocked, then the stand could be expected to regenerate successfully after clearcutting.

Marquis and others (1975) included this recommendation in a more detailed guide which prescribed the most appropriate treatment for cherry-maple stands depending on the regeneration potential. In determining this potential, they also recommended that some saplings and small poles of the slower growing tolerant sugar maple, beech, and hemlock be considered as large advance regeneration and that these stems be retained when the stand is harvested. This enables these species to compete successfully with the faster growing, less tolerant species, and both will be present in the main crown canopy of the next stand (Marquis 1981). Thus, adequate regeneration before clearcutting can be small advance regeneration only or a combination of these stems plus larger advance regeneration of saplings and small poles. The 1975 recommendations also increased the minimum number of regeneration plots to be examined from 10 to 20.

Many of the stands used by Grisez and Peace were reexamined again 5 years after cutting, and the data provide the basis for updating and improving the earlier guides to advance reproduction before cutting. The same data also have been used to develop a guide to estimate the success of the cutting in terms of the amount and size of the regeneration 2 to 5 years later. This report presents these revised regeneration guidelines.

Regeneration Before Cutting

To estimate the amount of advance reproduction needed to ensure successful regeneration, we first determined the regeneration success for a number of stands 5 years after cutting. Then, the before-logging inventories of advance reproduction were examined to see what combinations of species and number of stems best predicted success 5 years after cutting. Because advance reproduction of black cherry contributed so much to the success of the regeneration cuts, it was considered separately from the other desirable species. The criteria tested ranged from a combination of only 10 black cherry stems or 35 stems of other desirable species up to as many as 50 black cherry or 200 stems of all desirable species. They also considered the total number of stems regardless of species, acreage to be clearcut, and acreage of recent clearcuts in close proximity to the sample stand.

Of the many criteria considered, the most useful was the proportion of plots containing 25 black cherry stems or 100 stems of all desirable species. This criterion provided better results than the earlier criterion of 15 black cherry stems or 80 stems of desirable species:

[1] Desirable species include black cherry, sugar maple, red maple, white ash, yellow-poplar, cucumbertree, and red oak. In some locations, other commercial species such as beech, birch (yellow and sweet), basswood, oaks other than red oak, hickory, aspen, butternut, hemlock, and white pine may be considered in the desirable group.

	15/80 criterion	25/100 criterion
	percent	
Stands that met the advance regeneration criterion and could be clearcut	44	29
Proportion of the above stands that were clearcut and regenerated successfully	73	90

These data show that the 15/80 criterion permits clearcutting in a large number of stands that actually failed to regenerate (27 percent in this sample). The 25/100 criterion provides a much better success rate than all other criteria tested (only 10 percent failed). The 25/100 criterion is conservative because some stands that actually would regenerate do not qualify and therefore would not be clearcut. In such stands, we feel it is far better to use shelterwood cutting than to go ahead with clearcutting and risk failure.

In these tests, we used data for all seedling-size stems. However, in more recent studies, we have learned that seedling survival after clearcutting varies widely by size, age, and vigor. Seedlings over 6 inches tall with numerous leaves survive better than seedlings 2 to 6 inches tall. Seedlings less than 2 inches tall with fewer than 2 full-size leaves and seedlings that germinated in the current year survive poorly and should not be considered in regeneration assessments.[2]

For these reasons, we now redefine a stocked advance regeneration plot as one which has a minimum of 25 black cherry stems or a total of 100 stems of all desirable species less than 0.5-inch d.b.h. on a 6-foot-radius plot. In making this determination, do not count seedlings that are less than 2 inches tall, seedlings with fewer than two normal-size leaves or those that still bear cotyledons. Stems 2 to 6 inches tall with at least two normal-size leaves are counted in the usual manner. Stems over 6 inches tall with numerous normal-size leaves can be given extra weight. Count every two black cherry stems over 6 inches tall as three stems; count every stem of other desirable species over 6 inches tall as two stems. Thus, adequate stocking of advance regeneration may be achieved with fewer than 25 black cherry or 100 of other desirable species if some or all of them are large.

The requirements for large advance reproduction also are modified to be more stringent on tree quality and size but include fewer stems. To be stocked with large regeneration, a 6-foot-radius plot must contain one acceptable tree of sugar maple, beech, or hemlock 3 to 10 inches d.b.h. Acceptable trees have at least moderately good crowns and clean straight boles free of branches, epicormic branches, or other defects for at least the first 17 feet. Such trees usually survive and should develop into sawlog-quality trees in the future if left after cutting.

As in the past, at least 70 percent of the regeneration plots examined (a minimum number of 20 plots plus one additional plot for every 4 acres in stands over 20 acres) must be classed as stocked before successful regeneration of the stand can be expected. However, in stands where plots with large advance reproduction are included (and where this reproduction is to be retained after final harvest), at least 50 percent of the plots must be stocked with small advance reproduction and enough additional plots stocked with large advance reproduction to total at least 70 percent of the total number of regeneration plots.

Regeneration After Cutting

Guides to the amount of regeneration required at various ages after final harvest have never been developed specifically for the Allegheny hardwood type. The eastern region of the USDA Forest Service has used the rule that 70 percent of the regeneration plots (6-foot radius) examined must contain at least two stems of any height for the regeneration to be considered successful. Although this rule is probably acceptable in most areas, it is not adequate on the Allegheny Plateau where heavy deer browsing often destroys large numbers of seedlings. The two-stems-per-plot rule is applicable on the Plateau only if counts are limited to stems over 5 feet tall because these are assumed to have grown above the reach of deer. Therefore, do not consider regeneration after final harvest to be established in Allegheny hardwoods until at least 70 percent of the 6-foot-radius plots contain two stems over 5 feet tall. Most stands require 5 to 10 years to achieve this level.

To determine guides to the probable success of regeneration 2 to 5 years after harvest cutting, we examined the regeneration in 34 clearcuts at both 2 years and 5 years after cutting. We summarized the data using numerous stocking criteria, and then grouped the clearcuts into several categories. It was easy to determine those that were obviously successful (met all the criteria tried) and those that were obviously failures (failed to meet any of the criteria tested). But other stands were marginal, meeting some criteria but not others.

[2]Marquis, David A. Effect of advance seedling size and vigor on survival after clearcutting. Northeastern Forest Experiment Station. In preparation.

The criteria tested included: (1) information on the total number of stems per plot, and (2) information on the number of stems over 3 feet tall. Both types of information are important. Field observations show that several years after clearcutting Allegheny hardwood stands, the presence of stems over 3 feet tall indicates that deer browsing is not so severe as to prevent some stems from growing. Although not yet out of reach of deer, there is reason to expect that some will reach 5 to 6 feet in height in the near future. Total number of stems is also important in young clearcuts or in older ones being browsed heavily. Very large numbers of stems, even small ones, provide hope that a few will eventually escape browsing.

We found the most promising criteria for evaluation of regeneration 2 to 5 years after clearcutting to be: (1) the proportion of 6-foot-radius plots having at least 25 stems, and (2) the proportion of 6-foot-radius plots with at least five stems over 3 feet tall.

These two proportions are determined separately, and both are recorded for each plot. Along with the proportion of plots stocked with two stems over 5 feet tall, they provide three separate criteria for evaluation of regeneration stocking after final harvest cutting. These criteria can be used in various combinations to evaluate regeneration success and the need for supplementary cultural treatment as the new stand passes through several characteristic stages of development, as follows:

Stage 1 generally occurs during the first few years after cutting, but may be extended to 10 or more years if deer browsing is severe. During this stage, the proportion of plots stocked with 25 stems total is higher than the proportion stocked with five stems over 3 feet or two stems over 5 feet, and this criterion should be used by itself to indicate ultimate stand stocking. The scarcity of stems over 3 feet or 5 feet is normal for the first few years after cutting, before the stems have had a chance to grow much. If the proportion of plots with 25 stems total remains higher than the proportions for the other two criteria for more than 3 or 4 years, this indicates that something (such as deer browsing) is preventing normal height growth.

Stage 2 generally occurs 3 to 5 years after cutting in stands not subject to excessive browsing or occasionally sooner in stands that had large advance seedlings prior to cutting. At this stage, a good many stems have grown over 3 feet in height and the proportion of plots with 25 stems total and the proportion of plots with 5 stems over 3 feet are both high. The average of these two proportions is the best indication of the ultimate regeneration stocking. At this stage, not enough time has elapsed for many stems to grow above 5 feet, and the proportion of plots stocked with two over 5 feet is lower than is the proportion of the other two criteria.

Stage 3 generally occurs from 6 to 10 years or more after cutting in stands not subject to excessive browsing. At this stage, many stems have grown over 5 feet and competition resulting from crown closure reduces the total number of stems present. At this stage, the proportion of plots stocked with two stems over 5 feet is higher than the proportion stocked with either of the other two criteria, and the stand is established.

Thus, the future stocking of the stand can be estimated at any time from the proper combination of stocking criteria. The impact of deer browsing is also evidenced by delays in the time required for the new stand to progress through the several stages of development.

Need for supplementary silvicultural treatment likewise can be determined from these stocking data. If the stand is progressing through the various stages of development in the expected time with at least 70 percent stocking, the probability of regeneration success is high and no special treatments are needed. If stocking with 25 stems total is at least 70 percent, but the stems are not developing in height, deer browsing is probably hindering their progress; fertilization or fencing should be considered. If none of the three stocking criteria exceed 50 percent, the stand has a poor chance of success and fencing should be considered. If none of the three stocking criteria exceed 30 percent, fencing, planting, fertilization, and weed control may all be required to establish a new, fully stocked stand.

New stands are considered to be established successfully only when at least 70 percent of the plots contain at least two stems of desirable species over 5 feet tall. The other criteria provide an indication of probable outcome, but stands are still in the process of regeneration until the stems grow above the 5-foot height.

All three stocking criteria should be determined both for desirable species alone and for all commercial species. This permits the success or probable success to be specified in terms of these two species groups. When 70 percent or more of the plots are stocked with two or more stems of any species over 5 feet tall, the stand should be considered established, even though it may not be 70 percent stocked with desirable species. Further change in stocking of desirable species is unlikely after the site is occupied by other stems of large size.

Tallies of all stocking criteria can be made simply by checking appropriate boxes on a simple tally form (Fig. 1) to indicate that a plot meets the particular criterion. Then the number of boxes checked divided by the total number of plots examined provides an estimate of the percent stocking for each criterion.

Figure 1. Regeneration Tally

Advance regeneration date _____

Criteria	Plot No. →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	%
25 BC or 100 desirable spp	Small Regen																																
SM BEE HEM	Large Regen																																

Regeneration ___ years after logging date _____

Criteria	Plot No. →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	%
2 stems at least 5 feet tall	Desirable Spp.																																
	All Comm.																																
At least 25 stems any height	Desirable Spp.																																
	All Comm.																																
At least 5 stems 3 feet tall	Desirable Spp.																																
	All Comm.																																

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